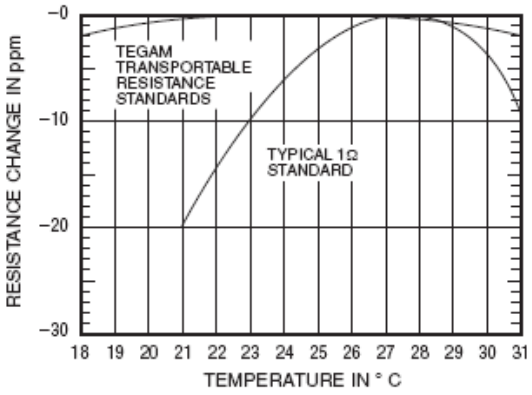
Transportable Resistance Standards

SR102/SR104

These Transportable Resistance Standards are designed for precision applications. Their accuracy, stability, and low temperature coefficient make them ideal for precise laboratory comparisons without critical environmental controls. For maximum accuracy, these standards offer users a temperature-correction chart and a built-in RTD temperature sensor to measure internal temperature.



Temperature coefficient comparison between a typical SR-102 unit and a typical 100 Ω resistance standard

Features

- High accuracy
- High stability -- <0.2 ppm/year
- Low temperature coefficient -- <0.1 ppm/°C
- Built-in temperature sensor and temperature-correction chart
- Oil-filled
- Hermetically sealed
- Increased-stability option (DC) is available to be used in an oil-bath

Transportable Resistance Standard

SPECIFICATIONS

Stability
First 2 years: ±1 ppm/year
Thereafter: ±0.5 ppm/year

Temperature coefficient
Temperature coefficient (α):
<0.1 ppm/°C at 23°C
1/2 rate of TC change (β):
<0.03 ppm/°C from 18°C to 28°C
α and β are determined by the following expression:

$$R_S=R_{23}[1+\alpha_{23}(t-23)+\beta(t-23)^2]$$

where R_S = Standard Resistance at temperature t
No ovens or external power required

Power coefficient
<1 ppm/W

Adjustment to nominal
±1 ppm

Measurement uncertainty
<0.32 ppm

Max voltage
500 V peak to case

Power rating
1 W (Momentary 100 W overloads will not cause failure)

Thermal emf
Thermal emf at the terminals does not exceed ±0.1 µV under normal conditions.

Insulation resistance
All terminals maintain a minimum 10^{12} Ω to ground

Internal temperature sensor
100 Ω, 1 k Ω, or 10 kΩ resistor with 1,000 ppm/°C temperature coefficient. Integral thermometer well is provided for calibration

Hermetic sealing
To eliminate the effects of humidity, the resistor is hermetically sealed in oil with metal-to-glass seals. The resistance changes <±0.1 ppm with normal atmospheric pressure and humidity changes.

Pressure effects
No pressure effects under normal atmospheric changes.

Connection terminals
Five-terminal construction, four-terminal resistor with ground intercept for the standard and temperature resistor.

Thermal emf
Thermal emf at the terminals does not exceed ±0.1 µV under normal conditions.

Thermal lagging
Thermal lagging time constant is 1 hour minimum (1-1/e of total change in one hour).

Dielectric soakage effect
The resistance stabilizes to within 0.1 ppm of final value within 5 seconds with 1 V applied to the resistor.

Current reversal
With the reversal of the current through the resistor, the resistance value changes less than ±0.1 ppm.

Shock effects
The resistance changes is <0.2 ppm when subjected to 2 drops three-foot drops to a concrete floor on each of the 3 mutually perpendicular faces (6 drops total).

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SAMPLE TEMPERATURE CORRECTION CHART

SR-104 RESISTANCE STANDARD

CONSULT INSTRUCTION MANUAL FOR PROPER INSTRUMENT OPERATION

IET Labs, Inc. A2LA Certificate Number 2073.01 ACCREDITED

Nominal Value: 10 kΩ
Power Rating: 1 W; momentary 100 W overloads will not cause failure.
Stability: ±1 ppm/ year, first 2 years. ± 0.5 ppm/year thereafter.
Breakdown Voltage: 500 V peak to case.
Power Coefficient: <1 ppm/W

R_{23} (resistance at 23.0 °C)= 10.000 002 96 kΩ
Dev. from nominal value= 0.296 ppm at 23.0 °C
For corrected resistance at other temperatures, see chart or graph or calculate as follows:

$$R_S = R_{23}\,[\,1 + \alpha_{23}(t-23) + \beta(t-23)^2]$$

Where R_S = Standard Resistance at temperature t
t = Actual temperature as determined by well thermometer or from Temperature Sensor Resistor (R_T) as below

α_{23} = 0.138 ppm/°C

β = -0.023 ppm/°C²

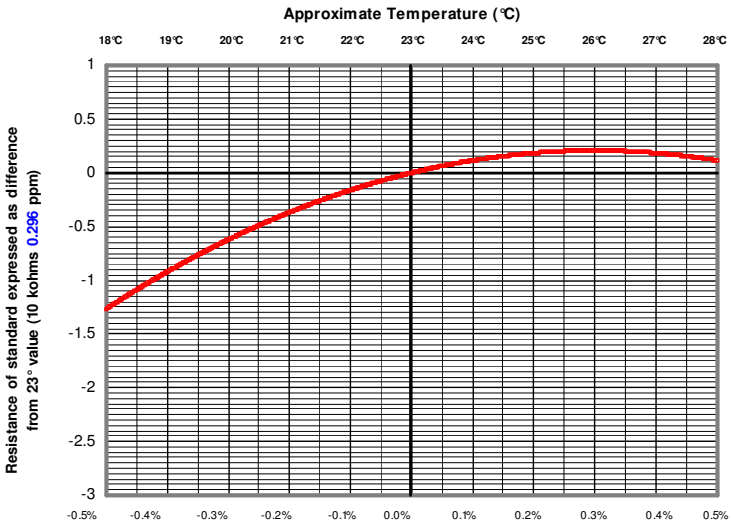
Temperature Sensor Resistance (R_T)
R_{T23} (sensor resistance at 23.0 °C)= 9.999 589 kΩ
Deviation from nominal value = -0.004 1% at 23.0 °C

$$T = \left(\frac{R_T - R_{T23}}{R_{T23}} \times 10^3 + 23\right)°C$$

Model: SR-104 SN: J1-1041623
By: JOS Date: 15-Nov-2010

Temp. (ºC)	Res. (kΩ)	Dev. from Nominal (ppm)
18.0	9.999 990 31	-0.97
18.5	9.999 992 09	-0.79
19.0	9.999 993 76	-0.62
19.5	9.999 995 31	-0.47
20.0	9.999 996 75	-0.33
20.5	9.999 998 07	-0.19
21.0	9.999 999 28	-0.07
21.5	10.000 000 37	0.04
22.0	10.000 001 35	0.13
22.5	10.000 002 21	0.22
23.0	10.000 002 96	0.30
23.5	10.000 003 59	0.36
24.0	10.000 004 11	0.41
24.5	10.000 004 51	0.45
25.0	10.000 004 80	0.48
25.5	10.000 004 97	0.50
26.0	10.000 005 03	0.50
26.5	10.000 004 97	0.50
27.0	10.000 004 80	0.48
27.5	10.000 004 51	0.45
28.0	10.000 004 11	0.41

History of Standard Deviation (ppm)



Temperature of standard resistor expressed as percentage change of Temperature Sensor Resistance (R_T) at temperature T from (R_{T23}) 9.999 589 kΩ.
e.g. if R_T =10.009 588 is 0.1% above R_{T23}, the resistance of the standard =10.000 004 11 kΩ.
(may also be obtained from the formula or the temperature chart)

WARNING

Observe all safety rules when working with high voltages or line voltages. Connect the (G) terminal to earth ground in order to maintain the case at a safe voltage. Whenever hazardous voltages (>45 V) are used, take all measures to avoid accidental contact with any live components: a) Use maximum insulation and minimize the use of bare conductors. b) Remove power when adjusting switches. c) Post warning signs and keep personnel safely away.

formerly manufactured by esi

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CAGE CODE: 62015

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SR104 Label/100%;/08-07-08

MECHANICAL INFORMATION

Dimensions

Regular
25.4 cm x 20.6 cm x 31.1 cm (10” x 8.1” x 12.25”)
Deleted case (DC) version
12.7 cm x 8.9 cm x 17.8 cm (5.0” x 3.5” x 7.0”)

Weight

Regular
4.8 kg (10.5 lb)
Deleted case (DC) version
1.8 kg (4.0 lb)

OPTIONAL EXTERNAL OIL BATH

This optional version can further enhance the short-term stability of the resistance standard. It comes without the insulated case, so that it may be used in an external oil bath that provides additional temperature stability. This version is called Deleted Case (DC).

When the standards are used in an oil bath, the resistance elements maintain a constant temperature, providing outstanding short-term stability, which is especially important when making Quantum-Hall-Effect measurements.

ORDERING INFORMATION

100 ohm Transportable Resistance Standard:	**SR-102**
1,000 ohm Transportable Resistance Standard:	**SR-103**
10,000 ohm Transportable Resistance Standard:	**SR-104**

Optional:
For deleted case version add -DC at the end of the part number.

Each unit includes:

- Built-in temperature sensor
- Temperature correction chart
- Instruction manual
- ISO/IEC 17025 calibration certificate